Space Weather Technical Forecast

Issued on Saturday, 29 June 2024 at 13:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares throughout. G1/Minor Storm intervals likely Day 1 (29 Jun), risk declining next few days.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are currently fifteen regions on the disc, most of which are small and simple. The largest regions are AR3719 on the southwest quadrant and AR3729 on the eastern central part. AR3719 has recently grown and become a little complex, with the addition of minor spots right behind the main one. AR3729 appears straightforward magnetically, its trailing part somewhat fragmenting and looking smaller. A new region is quickly developing to the north of this; it is currently relatively simple (Beta/Cro) but worth monitoring. Another region is also rotating onto the northeast limb but its analysis is still made difficult as it's not yet fully visible.

There are currently numerous filaments on the Earth-facing disc, one of which looking precarious on the southeast quadrant. It will closely monitored for any lift-off. No new Earth-directed CMEs have been observed in coronagraph imagery in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE and DSCOVR at L1 showed the presence of a magnetic cloud at the beginning of the period, associated with the CME that arrived earlier on the 28th. The solar wind speed has remained slightly elevated, around 430-490 km/s. Density was above average initially, peaking at 72ppcc for a very shorth time, but dropped after 28/1630 UTC to become average or even below average at times. The Interplanetary Magnetic Field, Bt, was strong and erratic initially, peaking at 25nT, but came back closer to 8nT after 28/1630 UTC and has remained stable ever since. Equally, the north-south component, Bz, started with a strong southward deviation of -15nT at 28/1200 UTC but has been less turbulent and mostly positive since 28/1630 UTC. Phi angle was variable under the presence of the magnetic cloud but has recently been mostly positive (away from the Sun). Geomagnetic activity has declined through the period, starting with a G4/Severe Storm (Kp 8) between 28/1200-1500 UTC before gradually easing down to mostly Quiet during the second part.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels. The 24-hour fluence remained below Active, with 1.0e6 integrated pfu observed at 29/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: The magnetic cloud associated with the CME that arrived at Earth on 28/0910 UTC is now waning. Two further and potentially Earth-directed CMEs have been observed leaving the sun, respectively on 25 and 27 June. They could both give Earth a weak glancing blow later on (end of) Day 1 and Day 2 but confidence is low, with large

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uncertainties in timing. There are no coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be Quiet to Unsettled with a chance of an Active interval but there is potential for a G1/Minor Storm (Kp 5) at the end of Day 1 (29th), should the expected glancing blow materialise and combine its effect with the current slightly elevated solar wind background. Conditions are then expected to become largely Quiet from Day 3 (01st) onwards.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels. However, there is a very slight chance of exceeding the S1/Minor Storm threshold should any notable flares occur. High energy electron flux might show an increasing trend in the next few days after the recent CME influence. The associated 24-hour fluence is likely to remain below the Active threshold, but with a slight chance of exceeding later in the period.

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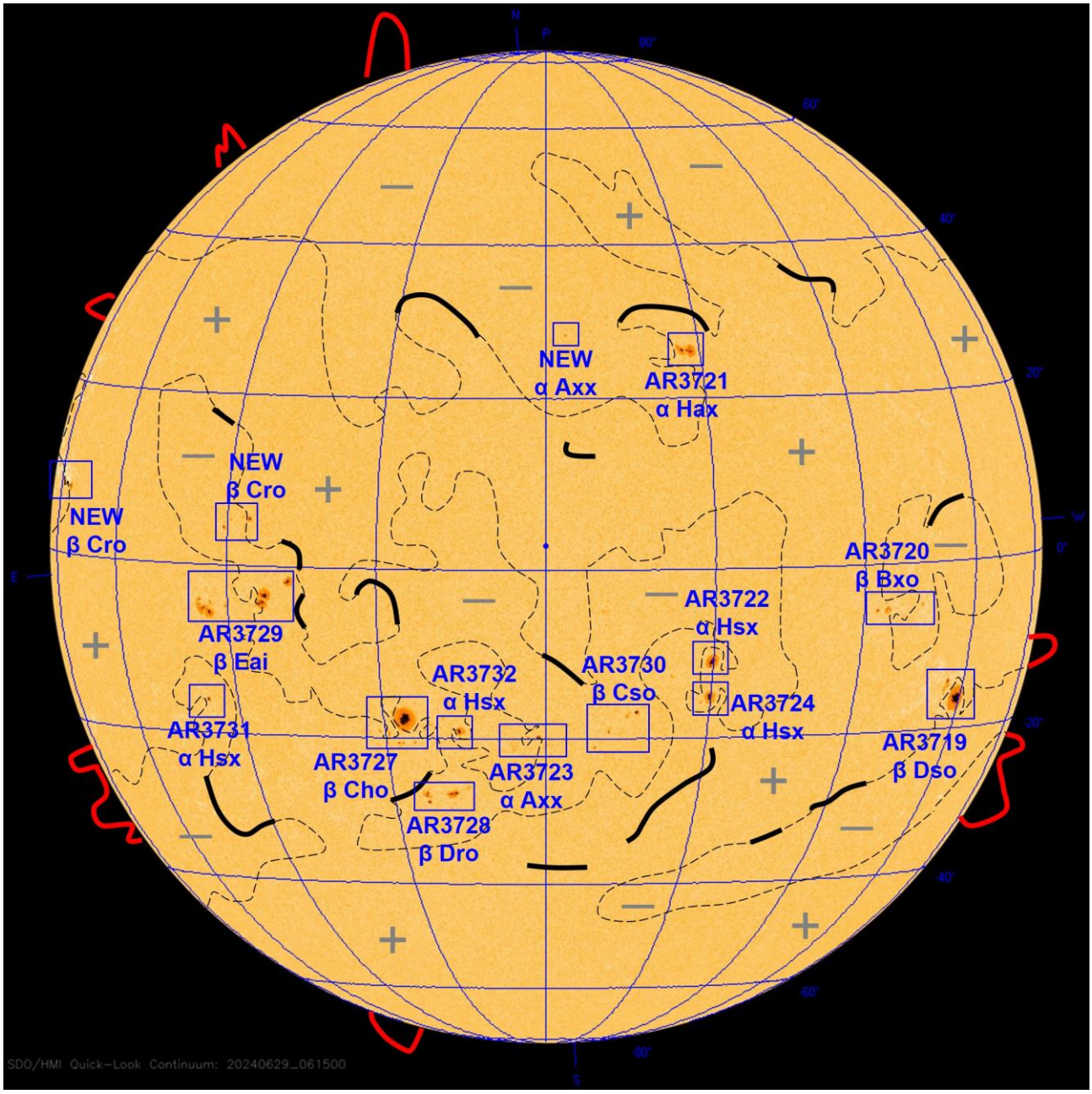
Figure 1. Solar Analysis Valid 29/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The magnetic cloud associated with the CME that arrived at Earth on 28/0910 UTC is now waning. However, two further and potentially Earth-directed CMEs have been observed leaving the sun, respectively on 25 and 27 June. They could both give Earth a weak glancing blow on Day 1 and Day 2 but confidence is low, with large uncertainties in timing. Indeed, the ejecta was faint and slow but given the already existing slightly elevated solar wind background, it may combine its effects and trigger a more potent geomagnetic response on Day 1, less likely on Day 2. There are no coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be Quiet to Unsettled with a chance of an Active interval but there is potential for a G1/Minor Storm (Kp 5) at the end of Day 1 (29th), should the expected glancing blow materialise and combine its effect with the current slightly elevated solar wind background. Conditions are then expected to become largely Quiet from Day 3 (01st) onwards.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	20	5	1
Strong	G3	Yes	1	1	1	1
Severe	G4	Yes	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
26/0701	Partial	AR3720 + filament	S-Centre	400 km/s	29/1200 UTC +/- 12 hrs	Only weak impacts likely
28/0200	Partial	AR3719	SW	390 km/s	30/0600 UTC +/- 9 hrs	Glancing blow possible

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Radio Blackouts - X-Ray Flares:
There are currently fifteen regions on the disc, most of which are small and simple. The largest regions are AR3719 on the southwest quadrant and AR3729 on the eastern central part. AR3719 has recently grown and become a little complex, with the addition of minor spots right behind the main one. AR3729 appears straightforward magnetically, its trailing part somewhat fragmenting and looking smaller. A new region is quickly developing to the north of this; it is currently relatively simple (Beta/Cro) but worth monitoring. Another region is also rotating onto the northeast limb but its analysis is still made difficult as it's not yet fully visible.

Far side sounding data and persistence suggest the potential for further regions to rotate around the eastern limb during the period, with AR3719 rotating off late on Day 3 (01 Jul) and AR3720 during Day 4 (02 Jul). Given that each region is only contributing to a small amount to the overall flare risk, a chance of isolated M-class flares is maintained throughout the period, with a very slight chance of isolated X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	45	45	45	45
Very Active	R3 to R5 X Class	No	5	5	5	5

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Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as measured by GOES-18, is most likely to remain at background levels. Despite a large amount of sunspots on the Earth-facing disc, they are relatively small and magnetically simple or not showing any tangible sign of imminent flare which could potentially enhance the proton flux.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is expected to continue at background levels for the start of the period. The recent CME enhancement may have caused an increase in electron flux below GEO, but the potential for further CME arrivals could suppress this once again. Overall, electron flux is most likely to stay at background levels, but as the solar wind speeds decline there is the possibility of an increase to peak at moderate or perhaps high levels later in the period.

Associated electron fluence is most likely to persist below the Active threshold (1e8 integrated pfu), but with a slight chance of an increase above Active later in the period. MOSWOC REFM is forecasting below Active through the next three days, which is the most probable outcome.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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